# Effects of Vibrations on Gaze Behavior in High-Speed Navigation


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## Introduction

In high-speed sports such as alpine skiing or mountain biking athletes have to deal with vibrations that can limit vision. More than half of the Swiss National Alpine skiing team stated that vibrations due to jumps and slope irregularities hamper their vision and performance (Urfer, 2011). For instance, one team member stated that *“when that happens, you don’t have a chance to see anything. You just ski on instinct”*. Interestingly, one of the most successful team members stated that *”although everything else gets completely shaken, the head, and especially the eyes, are somehow stable […] I never had the feeling that I could not see enough due to vibrations”.*

This qualitative analysis suggests that vibrations limit vision and that the ability to maintain vision despite the vibrations could be a characteristic of expertise. The current study aimed to quantify these suggestions in a controlled setting.

## Objective

The aim of the present study was to find out how vibrations influence motor behavior and visual perception of elite- and near-elite bikers in high-speed navigation around a curve.

## Method and Materials

Fourteen participants (7 elite-, 7 near-elite) rode around a pump track course in order to navigate through a 180 degree banked curve. As experimental manipulation, a five meter part of the course was covered with eight wooden slats spaced 60 cm apart to induce vibrations (see Figure 1).

Dependent variables are:
- Performance times of four sections (Entry section, Vibration manipulation section, Curve and Exit section) measured with light barriers.
- Gaze parameters (number, duration, location and relative timing of fixations) measured with a mobile gaze registration system (EyeSeeCam).

Fig. 1 Experimental set-up.

## Results

A 2 (Expertise) x 2 (Condition) x 4 (Section) ANOVA on Section times revealed main effects of Expertise, $F(1,12) = 8.42$, $p = .014$, and Vibration, $F(1,12) = 8.91$, $p = .015$, but failed to show any interactions between Expertise, Condition and Section (see Table 1).

Table 1. Average times of the 2 groups (Experts: E; Near-Experts: NE) under the two conditions (Control: C ; Vibration: V) in the four sections (1-Entry, 2-Manipulation, 3-Curve and 4-Exit)

| | section 1 | section 2 | section 3 | section 4 | total |
|---|---|---|---|---|---|
| EXP-C | 0.833 | 0.792 | 1.572 | 1.176 | 4.413 |
| EXP-V | 0.823 | 0.814 | 1.660 | 1.209 | 4.539 |
| NE-C | 0.943 | 0.837 | 1.751 | 1.324 | 4.720 |
| NE-V | 0.933 | 0.868 | 1.855 | 1.355 | 4.877 |

Fig. 2 EyeSeeCam.

Gaze analyses, currently still in progress, mainly seem to point towards Expertise effects with less fixations (Experts: $M = 4.0$, $SD = 0.94$; Near-Experts: $M = 6.2$, $SD = 0.84$), as well as more advanced fixations for Experts (see Figures 3 and 4).

Condition effects seem less profound, with equal number of fixations through the curve (Control condition: $M = 5.06$, $SD = 2.45$; Vibration condition: $M = 5.13$, $SD = 0.66$).

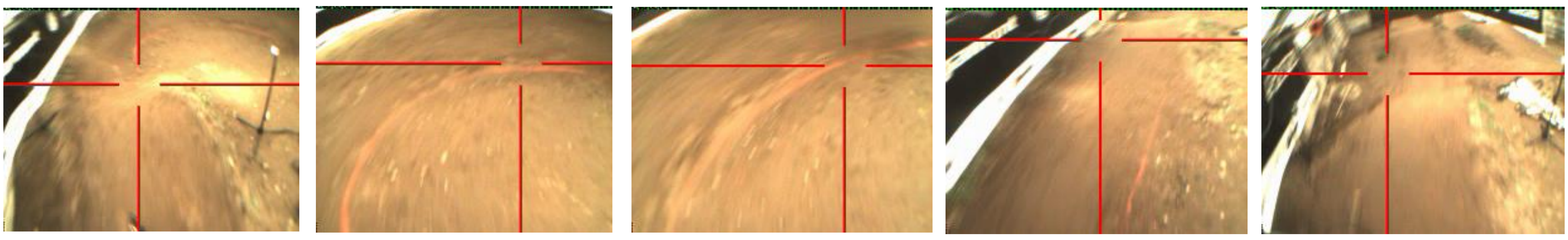

Fig. 3. Fixation locations of an Expert participant around the experimental curve.

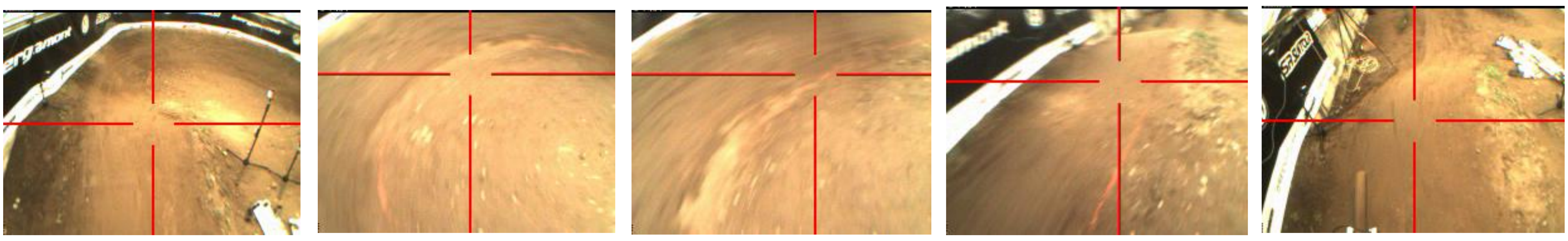

Fig. 4. Fixation locations of a Near-Expert participant around the experimental curve.

## Discussion

It seems that visual perception plays a mediating role in expert performance under demanding conditions. Differentiated perceptual characteristics related to vibrations as well as expertise oblige further analyses and research aimed at elaborating in-situ visual expertise under highly demanding environmental constraints.


References

Urfer, J. (2011). Die visuelle Wahrnehmung im alpinen skirennsport, Unpublished BSc-Thesis, University of Bern.



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